

requirements and dyed with the cyan dye and dried. This blue-green mask is placed in register with the green-filter negative (magenta printer) and a Wash-Off Relief positive for the magenta printer is made from this composite negative, consisting of the cyan-dyed mask and green-filter negative (magenta printer).

This relief is dyed magenta in the usual way and dried. Then the cyan- and magenta-dyed reliefs are both placed in register with the blue-filter negative (yellow printer) and the third relief (yellow printer) is made through the negative and two masks.

The Gevaert Company of America has introduced a method of correction by positive masking in the making of color separations from color transparencies, which is outlined below.

Kodak Masking Panchromatic Film is a dry-stripping panchromatic film which is used for masking Kodachrome transparencies when making separations from them.

The varnish is removed from the emulsion side of the Kodachrome and the stripped film cemented in contact with it. After exposure through the light from a red No. 25 filter, the complete sandwich Kodachrome Film and exposed stripping mask is placed in the developer. The stripping mask protects the Kodachrome during development, fixing, and washing.

The purpose of this negative mask is to add density to the highlights and red and yellow shadow areas with little or no density added to the blue-green and greens. At the same time, the Kodachrome is flattened for separating and color is corrected.

Contrast Correction. — For correction of contrast only, in order that the color transparency may be more easily separated, a light contact negative mask is made from the

color transparency on a Gevaert Normal Panchro or Ultra Rapid Panchro plate. This negative should record only luminosity differences and none of the color contrast. Exposure is made either without a filter or through a Wratten A filter.

If there is an overabundance of some particular color, it may be necessary to give in addition to the exposure through the Wratten A filter a second exposure on the same plate through some filter which transmits freely the particular color you want recorded above the exposure made through the yellow filter. This mask is registered with the transparency and separations made in the usual way.

Correcting Contrast and Color at One Time. — In order to correct the lack of perfect absorption and transmission of the dyes in the transparency, it is necessary, as explained before, to make corrections. In this case the corrections recommended by the Gevaert Company are made by contact negative masks placed in register with the colored transparency when the separations are made as follows:

To correct the recording of the negative made through the green filter (magenta printer) a weak negative mask is made by contact with the transparency through a magenta filter (Wratten 33). This, when bound in register with the transparency during the green-filter separation (magenta printer) exposure, will subtract magenta from the green areas, thereby purifying them. Other complementary filters which may be used for this purpose according to the color of the transparency are Wratten 31, 32, 34, and 35.

To correct the recording of the negative made through the blue filter (yellow printer) a weak negative mask is made through a yellow (minus blue) filter (Wratten 12). This removes a certain amount of yellow from the blues

and at the same time strengthens the yellows, which because of their high transmission would become diluted with white. Other filters suitable are Wratten 9, 15, and 16.

To prevent blue-green and green from separating out of proportion to their original tone values, a weak masking negative is made through a blue-green filter (Wratten 43-44A). This mask is combined with the color transparency when making the red-filter (cyan printer) exposure. This mask prevents dilution of the light blue and blue-green areas and, at the same time, subtracts blue-green from the yellow, orange-red, etc. Other filters suitable are Wratten 43, 44, 45, 64, 65, and 65A.

In making the separations described above, the transparencies were separated by the use of Gevaert Normal Panchro and Ultra Rapid Panchro plates in conjunction with the following Wratten filter combinations: Red 29; Green 61; Blue 49; Yellow K₂.

Film and Plate Data. — Following we give the characteristics and filter factors of the principal negative material used in this country for color-separation work. At the end of this chapter you will find grouped all the formulas as given by the makers of the materials mentioned.

Ansco Film Factor Charts. — By permission we give factors for Wratten filters as of January 1945, as compiled by Ansco for making direct-separation negatives. The factors given in the table below were determined from Superpan Press films developed in Ansco Formula 47 at 68 F (20 C). Development was carried out in a tray with constant agitation (30 rocks per minute) for the times shown.

FILTER	FILTER FACTOR*	DAYLIGHT 5400 K				
		GAMMA				
		4 Min.	6 Min.	8 Min.	11 Min.	14 Min.
No Filter	1	.61	.77	.87	.91	.95
No. 25 Red ...	15	.69	.86	1.03	1.08	1.12
No. 58 Green .	8	.55	.79	.90	.96	1.00
No. 47 Blue ...	6	.60	.73	.83	.90	.94

FILTER	FILTER FACTOR*	TUNGSTEN 3200 K				
		GAMMA				
		4 Min.	6 Min.	8 Min.	11 Min.	14 Min.
No Filter	1	.69	.79	.86	.94	.98
No. 25 Red ...	6	.74	.86	.98	1.10	1.16
No. 58 Green .	11	.74	.85	.96	1.01	1.04
No. 47 Blue ...	12	.68	.79	.89	.95	1.00

The following factors and developing times are for Isopan separation negatives developed in Ansco Formula A-17 at 68 F (20 C).

FILTER	FILTER FACTOR	DAYLIGHT 5400 K		
		GAMMA		
		6 Min.	9 Min.	12 Min.
No Filter	1	.62	.84	.98
No. 25 Red	8	.61	.90	1.07
No. 58 Green	15	.68	.94	1.14
No. 47 Blue	7	.60	.82	.97

FILTER	FILTER FACTOR	TUNGSTEN 3200 K		
		GAMMA		
		6 Min.	9 Min.	12 Min.
No Filter	1	.63	.84	.93
No. 25 Red	6	.66	.89	1.12
No. 58 Green	8	.64	.92	1.14
No. 47 Blue	8	.60	.82	1.00

Cramer Panchrome Plate. — An improved panchromatic plate, recommended for rigid requirements of continuous-tone color photography, which incorporates the highest color sensitivity to all visible colors, coupled with a fine-

* For development of the three negatives to a common gamma.

grained emulsion, and a clear-working scale of gradation of exceptionally long range, which is supplied in a special fine-grained mat surface when desired.

Cramer Panchrome Process Plate.—A very modern process panchromatic plate intended for line and direct half-tone color photography. Its special properties include extremely high sensitivity to green and red, very fine grain, uniform thin coating, high contrast, good resolving power (sharp line and dot formations), facile dot etching, and easy and certain manipulation.

WRATTEN FILTER FACTORS FOR CRAMER PLATES

Plate	K ₃	A*	F	B*	C ₄	C ₅ *	N ₆₁
Panchrome							
with white flame arc	6	18	36	20	14	4	
with Photoflood	2	4	12	10	18	4	
Panchrome Process							
with white flame arc	3	12	40	12	18	6	16
with Photoflood	2	6	20	7	40	12	16

Some photographers may prefer heavier filters for yellow, magenta, and cyan separation negatives from difficult originals and screen-plate and Kodachrome transparencies.

Defender X-F Panchromatic Film.—This film has a long brilliant scale with full shadow detail. Its color sensitivity has been revised to give increased sensitivity to orange and green and decreased sensitivity to dark red. This region (dark red) is one of very little color sensitivity; emulsion sensitivity there only adds to the possibility of fog. The increased green sensitivity gives a color response more nearly like that of the human eye. It has a neutral tint non-halation backing, which disappears in the processing.

* Filters marked with asterisk are the standard three-color filters.

Defender Fine Grain Panchromatic Film.—A fine-grain, full color sensitivity, and exceptionally smooth gradation are its characteristics. It has the same neutral tint non-halation backing as the X-F Panchromatic. It is capable of being developed to a high contrast if desired. A booklet, "Film By Defender," with a wealth of detailed information on the above and on other Defender Film may be obtained from your dealer. Tables, developer formulas, etc. are by permission of the Defender Division of the Du Pont Photo Products Department, Rochester, New York.

Defender Film and Filter Factors.—All Defender filters are lacquered and may be cleaned with a soft damp cloth. Do not use a dry cloth. Below we give the grouping to which the filters belong, followed by the filter factors.

Tricolor Separation Filter Sets for Defender Films.—**Tricolor Set A:** Standard Tricolor Filters 40R, 40G, 50B. These filters are similar in exposure and transmission to the standard A, B, C₅ tricolor sets. Filter factors for use with the standard tricolor set vary with each emulsion coating and are listed in each package of film for that particular emulsion.

Tricolor Set D: For direct color separation with daylight or daylight fluorescent lighting and Defender X-F Pan, use 40R, 50G, 100B. When so used these filters provide approximately 1:1:1 exposure ratios. The blue-record film must be developed an extra 25 per cent for proper negative contrast balance.

Tricolor Set M: For direct color separation with Mazda lighting and Defender X-F Pan film, filters 50R, 50G, 50B provide approximately 1:1:1 exposure ratios. The blue-record film must be developed approximately 25 per cent longer to obtain a set of negatives with balanced contrast.

Tricolor filter sets have not been developed for use with

Defender Arrow Pan because Arrow Pan is no more blue-sensitive than X-F Pan. No advantage would be gained in filter exposure times, since the filter sets would have to equalize the blue sensitivity of these two emulsions.

EXPOSURE RATINGS FOR DEFENDER FILM

	RATIOS		WESTON RATINGS	
	Daylight	Tungsten	Daylight	Tungsten
Arrow Pan5	.25	100	64
X-F Pan	1.0	1.00	50	32
Fine Grain Pan	2.0	2.00	24	16

Due to the group number method adapted by the Weston Electrical Instrument Corporation, there will be discrepancies between the relationship of these numbers and Defender ratios. For example, one film may be in the lower section of one Tungsten group and in the upper section of one Daylight group; hence Weston ratios will not always check with actual ratios. However, if Weston speed figures are intelligently used with a meter, good exposures will always be obtained.

Gamma is the numerical expression given to the exact measurement of steepness of gradation. The average portrait negative has a gamma of about 0.7, landscape and commercial subjects between 0.9 and 1.0. There is considerable variation in personal preference, and the printing process used must be considered.

The following tables enable users of Defender films to control understandingly the contrast or steepness of gradation of their negatives. The time of development at 68 F (20 C) is shown in minutes opposite each film under the different developers.

Film	Developers				
	1-D	2-D	3-D	4-D	6-D
Arrow Pan	4	5½	3½	7½	12½
X-F Pan	4½	4½	3	9	18
Fine Grain Pan	4½	4½	3	5	6

Film	Developers				
	1-D	2-D	3-D	4-D	6-D
Arrow Pan	5½	10	4½	10½	18
X-F Pan	7½	7	7	14	13
Fine Grain Pan	7½	7	5	12	10½

Film	Developers				
	1-D	2-D	3-D	4-D	6-D
Arrow Pan	6½	13	5½	12	20½
X-F Pan	10½	8½	9½	17	17
Fine Grain Pan	9	9	6½	17	14

Film	Developers				
	1-D	2-D	3-D	4-D	6-D
Arrow Pan	9		9	18	
X-F Pan	19				
Fine Grain Pan	13½		20		

Eastman Plates and Films. — The Eastman Kodak Company recommends that panchromatic emulsions be used for each of the three separations through the filters recommended in the chart below. Kodak Tri-X Panchromatic Film and Kodak Tri-X Panchromatic Type B Plates are especially recommended for color separation negatives.

Filters for use with these are Wratten A (No. 25), B (No. 58) and C₅ (No. 42). The Wratten K₂ filter is used when a fourth printer is made, usually black, in photoengraving work. The difference in filter factors for the various light sources should be carefully noted. All Kodak Plates have an antihalation backing.

Below we give a list of filter factors for Eastman plates and films. You will note that the emulsions are in two groups, B and C. All Eastman panchromatic materials are divided into groups. The negative materials of any one group are sufficiently similar in color sensitivity so that the same filter factors apply.

We are showing only the panchromatic emulsions in which we are now concerned. A complete factor chart will be found in the Kodak Data Book "Filters and Polar-Screens."

WRATTEN FILTER FACTOR CHART

Type B Emulsion

Wratten Process Pan Plates

Wratten Pan Plates

Kodak Tri-X Pan type B Plates

Type C Emulsion

Tri-X Pan Film

Super Panchro-Press Plates

Filter Sunlight Tungsten

Filter Sunlight Tungsten

Filter	Sunlight	Tungsten	Sunlight	Tungsten
A	7	4	4	2
B	6	6	7	6
C ₅	5	10	5	10
F	15	8	8	4
N	7	7	9	8
C ₄	12	24	12	24
K ₂	2	1.5	2	1.5
K ₃	2	1.5	2	1.5

The filter factors given will serve only as a general guide. With each package of Kodak film or plates you will find

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individual filter factors for the particular emulsion with which they are coated. In actual practice these individual filter factors and development times recommended in the instruction sheets should be used.

Emulsion Speeds and Development Times. — The following tables are published by permission of the Eastman Kodak Company.

Kodak Tri-X Panchromatic Type B Plates. —

SPEED AND RECOMMENDED METER SETTINGS

Light Source	Kodak Speed	Film Exposure Index
Daylight	0640	160
Tungsten (Photoflood)	100

For color separation work, Kodak Developers DK-50 and D-76 are recommended. To produce color separation negatives of medium contrast (gamma about 0.8), dilute Kodak Developer DK-50 1:1 and develop the plates for the times indicated in the table below.

APPROXIMATE DEVELOPMENT TIMES IN DK-50 (1:1) at 68 F (20 C)

	Red	Green	Blue	K ₂
Tray	6	7	11	7
Tank	8	9	14	9

If a shorter time of development is preferred, as in photo-mechanical work, use Kodak Developer DK-50 full strength and develop about 25 per cent less than the times given above.

For low contrast (gamma 0.6, or less), use Kodak Developer D-76 full strength for the development times given in the table. Kodak D-76 can also be used for medium contrast. Variations in contrast can be obtained with this developer by varying the developing time as follows:

NATURAL COLOR PROCESSES

APPROXIMATE DEVELOPMENT TIMES IN D-76.

Full Strength at 68 F (20 C)					
Contrast	Method	Red	Green	Blue	K ₂
Medium	Tray	8	9	13	9
	Tank	10	11	16	11
Low*	Tray	5½	6	8	6
	Tank	7	7½	10	7½
Very low**	Tray	4	4	5	4
	Tank	5	5	6½	5
Extremely low***	Tray	2½	2½	3	2½
	Tank	3	3	4	3

Kodak Super Pancho-Press Plates. —

SPEED AND RECOMMENDED METER SETTINGS

Light Source	Kodak Speed	Film Exposure Index
Daylight	0400	100
Tungsten		80

These plates may be developed in any developer commonly used for plates or films, but Kodak DK-50 is recommended. Use without dilution. If a shorter development time is required use either Kodak DK-60a or Kodak D-19 for the times indicated below.

APPROXIMATE DEVELOPMENT TIMES AT 68 F (20 C)

Developer (fresh)	Tank	Tray
Kodak DK-50	7 minutes	5½ minutes
Kodak DK-60a	4 minutes	3 minutes
Kodak D-19	4½ minutes	3½ minutes

Kodak developers DK-50, DK-60a, and D-19 in prepared powder form are obtainable in several package sizes convenient for use. Greater or less contrast may be obtained by developing longer or shorter times than those indicated.

* Gamma about 0.6 recommended for color separations from Kodachrome transparencies.

** Gamma about 0.4 recommended for color separations from very contrasty Kodachrome transparencies.

*** Gamma about 0.2 recommended for negative masks.

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Kodak Tri-X Panchromatic Sheet Safety Film. —

SPEED AND RECOMMENDED METER SETTINGS

Light Source	Kodak Speed	Film Exposure Index
Daylight	0800	200
Tungsten		160

Kodak DK-60a is recommended for developing this film. Use without dilution and develop as follows:

APPROXIMATE DEVELOPMENT TIMES IN DK-60a

at 68 F (20 C)

Method	Average Contrast	Maximum Contrast
Tray	5 minutes	9 minutes
Tank	6 minutes	12 minutes

All developer formulas will be found at the end of this chapter.

Gevaert Panchromatic Plates and Films. — These are used for continuous-tone separation work. They all come with antihalo backing which comes off in development.

Gevaert Normal Panchromatic is a fine-grain, long-scale plate of medium contrast with considerable latitude in exposure plus a high and balanced sensitivity to all colors of the visible spectrum used for color separation negatives in photomechanical work, rotogravure, and indirect lithography; Weston rating 16.

Gevaert Ultra Rapid Panchromatic plates have a long rich gradation scale, medium soft contrast, and are suitable for color photography either for consecutive A, B and C₅ separation exposures or in one-shot color cameras; Weston rating 50.

Gevaert Ultra Pancho film is fast and fine-grain with long-scale gradation, of medium-soft contrast, well-balanced color sensitivity, and is suitable for all continuous-tone color separation work; Weston rating 50.